SPECIAL FLOOD HAZARD INFORMATION REPORT

[WEST] GALLATIN RIVER

GALLATIN COUNTY MONTANA

PREPARED FOR

CITY OF BOZEMAN — COUNTY OF GALLATIN

MONTANA DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION

BY

DEPARTMENT OF THE ARMY, OMAHA DISTRICT, CORPS OF ENGINEERS, 68102

MAY 1973

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Introduction

The Gallatin River flows through a rural area in southwestern Montana. Recognizing that the river periodically floods and would be a threat to future development, officials of Gallatin County and the City of Bozeman requested through the Montana Department of Natural Resources and Conservation a general definition of the 50-year flood outline.

The basin and stream characteristics, flood histories, and probable effects of major flooding are defined. A general definition of the 50-year flood outline is provided. Profiles of both the 50-year flood and 100-year flood are shown. Reference points are provided with which to correlate data on the various plates and in tables provided in the report text. The outline for the 100-year flood, which has recently been enacted by the state legislature as the regulatory standard, would be slightly larger than the 50-year flood outline presented and could be adjusted in localized areas based on the profile data.

The flood plain is free of extensive residential, commercial, and industrial development. Past flooding along the Gallatin River has produced only localized damages. Federal flood projects in the study reach consist of limited emergency erosion control measures in the Baker Creek area and the repair of local levees.

The information presented in this report does not imply any Federal interest or authority to zone or regulate use of the flood plains, nor should it be construed as obligating the Government to investigate, construct or maintain any facility discussed herein. The use to which flood plain information will be put, such as zoning or other regulation of the flood plain, is the responsibility of local authorities. The Omaha District, Corps of Engineers will provide, upon request, technical assistance to Federal, State and local agencies in the interpretation and use of the information in this report. A pamphlet "Guide Lines for Reducing Flood Damages", and a booklet "Introduction to Floodproofing", can be supplied.

Basin and Stream Characteristics

The Gallatin River drains 1,840 square miles from its origins in Yellowstone National Park to where it joins the Missouri River near Three Forks, Montana. The Gallatin River upstream from the juncture with the East Gallatin River is frequently called the West Gallatin River. The study reach extends 45.2 miles upstream from the river mouth to a few miles upstream of Gallatin Gateway, Montana. Gallatin Gateway marks the emergence of the Gallatin River from mountain canyons, where the stream slope is 38 feet or more per mile, into a wide, highly cultivated valley, where the stream slope is considerably less, as shown in table 1. There are no flood control structures in the basin. In 1969, a levee was constructed by the Corps of Engineers in the Baker Creek area as an emergency measure under Project Foresight to prevent main stream flows into Baker Creek. The stream in the study reach is typically tree lined with frequent sand bars with materials grading up to cobblestones in size. The natural condition of the river, noted for trout fishing, supports an outstanding wildlife habitat and provides a valuable public asset, a factor to be duly considered by water resource planners. Photographs of the channel in the study reach are reproduced on pages 4 and 5. A location map is shown on plate 1.

Table I

STREAM SLOPES IN STUDY REACH

GALLATIN RIVER

Location by Reference Point	Length of Reach, Miles	Channel Slope, ft./mile
Upstream limit to Ref. Pt. 11	3.6	28.6
Ref. Pt. 11 to Ref. Pt. 31	6.0	38.0
Ref. Pt. 31 to Ref. Pt. 37	3.2	27.2
Ref. Pt. 37 to Ref. Pt. 48	2.3	40.8
Ref. Pt. 48 to Ref. Pt. 79	10.8	29.2
Ref. Pt. 79 to Ref. Pt. 108	7.2	20.2
Ref. Pt. 108 to Mouth	12.1	10.0
Total Length	45.2	

Development on the Flood Plain

There are no urban areas in the study reach flood plain. Residential development there consists of scattered vacation cottages, permanent houses, and mobile homes. The flood plain land use is about 75 percent pasture and miscellaneous and 25 percent for cultivated crops, both dry land and irrigated. Nearby Bozeman, Montana and several small communities provide trade and service industries for an agricultural economy in the basin. Many tourists and sportsmen are attracted to the Gallatin River area by the proximity of Yellowstone National Park, local historical and scenic attractions, and abundant opportunities for fishing and big game hunting. Since the study reach flood plain is not extensively developed and there is an abundance of land available for development outside of the flood plain, the situation appears ideal for the application of flood plain zoning to prevent future flood losses. Flood proofing may be applicable to some existing developments. This would include such

Figure 1. Aerial view of Gallatin River Central Park area, illustrates meandering channel.

Figure 2. Typical Gallatin River channel conditions, Central Park area - note gravel bars and brush.

Figure 3. View upstream to foothills, Gallatin River, Gallatin Gateway area.

Figure 4. Typical channel conditions, Gallatin River, Belgrade area.

considerations as raising of building foundations, waterproofing of basements, construction of ring levees, placing backup prevention valves in sewer lines, provision for the closing of building openings, and similar techniques.

Flood History on the Gallatin River

Annual peak flow records for many years are available from U. S. Geological Survey gaging stations near Gallatin Gateway near the upstream limit of the study reach, and at Logan, Montana about 6 miles upstream from the mouth of the Gallatin River. The gage locations are shown on plate I and flood records at the gages are presented in table 2.

Table 2 presents peak flows in excess of 6,400 cubic feet per second, a discharge level where flooding might reasonably begin. Exceptions are readings in February 1963 and January 1971 when high stages resulted from ice jams rather than from high peak discharges. Ice jam conditions in the winter and early spring have caused the worst floods in terms of high stages, while erosion damages to irrigation structures and bridges during prolonged high snowmelt runoff have been the most costly effects of flooding. Stream overflow in cold weather often freezes and ice may remain on the land for several months.

Few details are available concerning damages during past floods in the study reach. Because of sparse development, flood damages have not been extensive. In March and April 1952, snowmelt runoff caused flooding throughout the study reach. County roads and bridges were damaged and 350 acres were flooded on 14 farms. Although not mentioned, ice may have been a factor since the peak discharge occurred in June with no recorded damages. Rapid snowmelt resulted in floods on some stretches of the Gallatin River in June 1959 but no damages were reported. On 4 through 6 February 1963, unseasonably warm temperatures resulted in fast snowmelt and ice jams that caused severe flooding, "the worst flood in 54 years" at Logan, according to local people. Comparing the peak stage

Table 2

HISTORICAL FLOOD PEAK STAGES AND DISCHARGES

GALLATIN RIVER [1]

	near GALLATIN GATEWAY [2]			at LOGAN [3]		
Year	Date	Stage ft.	Maximum Discharge c.f.s.	Date	Stage ft.	Maximum Discharge c.f.s.
1892	20 June	7.70	8,060			
1893	12 June	7.00	6,800			
1894	2 June	7.70	8,060			
1896				18 June	5.60	6,550
1897				26 May	4.70	6,460
1898				19-20 June	5.25	7,300
1899				21 June	6.25	9,840
1943	19 June	5.61	6,480			
1948	4 June	5.77	6,740	5 June	8.40	7,870
1952	6 June	5.71	6,910	7 June	7.78	6,640
1956	28 May	5.57	7,030	29 May	7.97	7,190
1959	15 June	6.23	7,230			
1963				5 Feb	11.88*	4,000
1964	8 June	5.70	6,450			
1965	13 June	6.02	7,010			
1967				13 June	7.90	6,950
1968	20 June	5.66	6,570	14 June	7.97	7,280
1970				10 June	9.03	9,390
1971				7 Jan	9.30*	
1971				28 June	8.74	8,480

[1] From U.S.G.S. Water Supply Papers

[2] Gage located 7.3 miles south of Gallatin Gateway. No record between 1894 and 1931. Discontinued September 1969.

[3] Gage located 0.5 mile west of Logan; 6 miles upstream from mouth. No record between 1905 and 1929.

* Ice jam flood

and discharge for this flood with similar readings for other years, as shown in table 2, well illustrates how ice jams can cause high stages despite relatively low peak flows. About half of Logan was evacuated and 20 residences were flooded over the first floor level. Flooding in the Logan area caused by snowmelt and general rains in 1970 was considered minor in spite of a near record peak discharge at the Logan gage. During the 1970 flood, the river flowed at high levels from 20 May to the latter part of June. Flooding also occurred along the Gallatin River in June and July of 1971.

Potential Floods

Floods much larger than past floods in the study reach are possible. Most future floods, however, will be comparable in size to the past floods listed in table 2. To estimate the effect of future large floods, peak discharges were computed at several locations in the study reach for the 50-year and 100-year floods. The peak discharges were computed using the Log Pearson Type III method. The potential flood peak discharges at the highway crossing east of Manhattan, Montana were the lowest of the study reach. The decrease in flow here is largely due to overflow from the main channel into the Baker Creek drainage course. The main stream overflows into Baker Creek near Reference Point 62 and the overflow re-enters the main channel near Reference Point 99. Potential peak discharges at several locations along the Gallatin River are listed in table 3. Measured flows on 3 and 4 June 1972, used for reference in developing the profiles, are also presented in table 3.

Table 3

PEAK DISCHARGES OF POTENTIAL LARGE FLOODS

AND FLOWS OF 3-4 JUNE 1972

Location	June 1972 Flow Peak Discharge c.f.s.	50-Year Flood Peak Discharge c.f.s.	100-Year Flood Peak Discharge c.f.s.
Gallatin Gateway, U.S.G.S. Gage	4,750	9,150	9,750
U.S. Highway 191 Bridge	4,780	9,100	9,900
Williams Bridge	4,820	9,100	10,000
Gallatin Gateway	4,390	9,100	10,000
Axtel Bridge	4,710	9,000	9,800
Shed's Bridge	4,280	8,500	9,300
Cameron Bridge	4,040	8,300	9,100
Belgrade Bridge	3,710	8,000	8,900
Central Park Bridge	3,930	7,800	8,700
Manhattan E. Bridge (Ref. Pt. 96)	3,440	7,700	8,500
Manhattan N. Bridge (Ref. Pt. 100)	4,300	9,200	10,200
Logan, U.S.G.S. Gage (Ref. Pt. 124)	4,900	9,470	10,300
Trident Bridge	4,900	9,500	10,300

Hazards of Large Floods

A thorough study of historic floods was made to establish 50- and 100-year flood stage-discharge relationships at 14 sites. The information was then correlated with high flows measured in the spring of 1972 to define the flood potential at each reference point. Flood outlines were established from records and measurements on detailed aerial photographs and then transferred to the aerial photographs used in the report. This information, supplied by the U.S. Geological Survey, provided the basis for defining the flood potential shown in the report. The areas

flooded by the 50-year flood in the study reach are shown on plates 2 through 13. Average flood plain widths for the 50-year flood are listed by reach in table 4.

Table 4

AVERAGE FLOOD PLAIN WIDTHS

River Reach by Reference Point	Average Flood Plain Width, Ft. for 50-Year Flood
Ref. Pts. 1 thru 10	320
Ref. Pts. 10 thru 15	1,060
Ref. Pts. 15 thru 23	1,630
Ref. Pts. 23 thru 30	1,120
Ref. Pts. 30 thru 32	1,630
Ref. Pts. 32 thru 34	1,230
Ref. Pts. 34 thru 37	2,020
Ref. Pts. 37 thru 40	980
Ref. Pts. 40 thru 49	2,240
Ref. Pts. 49 thru 52	2,680
Ref. Pts. 52 thru 67	3,560
Ref. Pts. 67 thru 77	2,520
Ref. Pts. 77 thru 92	1,660
Ref. Pts. 92 thru 107	3,750
Ref. Pts. 107 thru 114	1,850
Ref. Pts. 114 thru 123	1,200
Ref. Pts. 123 thru 129	830
Ref. Pts. 129 thru Mouth	2,400

Water surface profiles for the 50-year and 100-year floods, as well as a high water profile measured in 1972, are shown on plates 14 through 21. Reference points are provided to correlate the profiles with the flooded area maps and data in table 5. The solid line connecting the reference points on the flooded area maps provides a base for measuring distances between reference points rather than for defining the precise channel centerline. Flood elevations shown on the profiles extend on a line perpendicular to the longitudinal axis of the flood plain.

The Gallatin River in the study reach is crossed by 13 highway bridges and 4 railroad bridges. In some instances the bridge crossings create obstructions to the flood flows, as indicated on the profiles.

The worst flooding condition in terms of peak discharges and hazard to human life would occur by a combination of a large rainstorm in conjunction with heavy snowmelt runoff. Flooding in the upstream study reach follows only a few hours after a storm and moves downstream to the mouth in from 12 to 24 hours. Warning time would be very important to residents of the flood plain should such an event occur. The National Oceanic and Atmospheric Administration, National Weather Service, makes river stage forecasts based on radar coverage, reports from two river stations, and about nine rainfall reporting stations in or near the basin. The Weather Service office at Helena, Montana is responsible for providing flash flood warnings for the Gallatin County area. Radar network coverage provides immediate detection and evaluation of rainfall intensity, and location and movement of storms. Information is promptly released to news media and to local officials.

Flood duration, especially during periods of high snowmelt, is an added hazard. Erosion resulting from prolonged high stream flows can cut away stream banks and damage or destroy nearby roads and structures such as bridges and diversion works.

Areas of high overbank flow velocity should be avoided during flooding. Generally water velocities greater than 3 feet per second combined with flood

depths of 2 feet or more are considered hazardous. Such velocity conditions would exist at many locations during a large flood. Travel through such areas should be avoided except in emergencies.

GLOSSARY OF TERMS

Deck

Surface of roadway or top of railroad ties at center of bridge.

Fifty-Year Flood

A flood magnitude expected to recur on the average of once every fifty years, or which has a two percent chance of occurring in any given year.

Flood

An overflow of lands not normally covered by water and that are used or usable by man. Floods have two essential characteristics: The inundation of land is temporary; and the land is adjacent to and inundated by overflow from a river or stream or an ocean, lake or other body of standing water.

Normally a flood is considered as any temporary rise in stream flow or stage, but not the ponding of surface water, that results in significant adverse effects in the vicinity. Adverse effects may include damages from overflow of land areas, temporary backwater effects in sewers and local drainage channels, creation of unsanitary conditions or other unfavorable situations by deposition of materials in stream channels during flood recessions, rise of ground water coincident with increased stream flow, and other problems.

Flood Crest

The maximum stage or elevation reached by the waters of a flood at a given location.

Flood Plain

The relatively flat area or low lands adjoining the channel of a river, stream or water course or ocean, lake or other body of standing water, which has been or may be covered by floodwater.

Flood Profile

A graph showing the relationship of water surface elevation to location, the latter generally expressed as distance above mouth for a stream of water flowing in an open channel. It is generally drawn to show surface elevation for the crest of a specific flood, but may be prepared for conditions at a given time or stage.

Flood Stage

The stage or elevation at which overflow of the natural banks of a stream or body of water begins in the reach or area in which the elevation is measured.

One Hundred Year Flood (Intermediate Regional Flood)

A flood having a one percent probability of occurrence in any year or an average frequency of occurrence in the order of once in 100 years. The flood may occur in any year. It is based on statistical analyses of stream flow records and analyses of rainfall and runoff characteristics in the general region of the watershed.

Left Bank

The bank on the left side of the river, stream or water course, looking downstream.

Reference Point

A numbered point identifying a specific location for correlating the data shown in various forms throughout the report.

Right Bank

The bank on the right side of a river, stream, or water course looking downstream.

AUTHORITY, ACKNOWLEDGEMENTS AND INTERPRETATION OF DATA

This report has been prepared in accordance with the authority granted by Section 206 of the Flood Control Act of 1960 (Public Law 86-645), as amended.

The flood profiles and flooded area maps were developed by the U. S. Geological Survey, Water Resources Division, Helena, Montana for the Omaha District, Corps of Engineers.

This report presents the flood situation along the Gallatin River in Gallatin County, Montana. The Omaha District of the Corps of Engineers will provide interpretation and limited technical assistance in application of data presented herein.

Table 5

FLOOD PLAIN REFERENCE DATA

GALLATIN RIVER

Identification	Reference Point Number	Distance From Mouth Feet	1972 Flood Elevation Ft. M.S.L.	50-Year Flood Elevation Ft. M.S.L.	Intermediate Regional Flood Elevation Ft. M.S.L.
Upstream Limit of Study	1	238,720	5126.5	5128.0	5128.5
	2	235,410	5107.3	5109.3	5109.9
	3	235,290	5107.0	5108.9	5109.4
Hwy. 191 Bridge	4	235,080	U/S 5106.9 D/S 5106.3	U/S 5108.8 D/S 5108.3	U/S 5109.3 D/S 5108.8
	5	234,920	5105.2	5107.2	5107.7
	6	226,220	5053.6	5055.6	5056.1
	7	226,010	5052.2	5054.0	5054.5
Williams Bridge	8	225,880	U/S 5052.1 D/S 5051.5	U/S 5053.9 U/S 5053.3	U/S 5054.4 U/S 5053.9
	9	225,780	5051.4	5053.3	5053.9
	10	224,720	5046.5	5048.4	5049.0
	11	217,700	5023.7	5025.5	5026.1
	12	217,810	5005.3	5007.2	5007.8
	13	216,080	4992.0	4994.0	4994.5
	14	215,600	4989.6	4991.5	4992.0
	15	213,750	4976.4	4978.4	4978.9
	16	210,280	4953.8	4955.9	4956.5
	17	206,800	4928.9	4931.0	4931.5
	18	204,920	4912.9	4914.8	4915.3

U/S Upstream Side of Bridge

D/S Downstream Side of Bridge

Table 5 (Continued)

FLOOD PLAIN REFERENCE DATA

GALLATIN RIVER

Identification	Reference Point Number	Distance From Mouth Feet	1972 Flood Elevation Ft. M.S.L.	50-Year Flood Elevation Ft. M.S.L.	Intermediate Regional Flood Elevation Ft. M.S.L.
	19	204,580	4912.4	4914.3	4914.8
Gallatin Gateway Bridge	20	204,470	U/S 4912.3 D/S 4911.0	U/S 4914.2 D/S 4912.9	U/S 4914.7 D/S 4913.4
	21	204,330	4910.7	4912.6	4913.1
	22	202,290	4897.7	4899.5	4900.1
	23	200,580	4883.4	4885.4	4885.9
	24	198,600	4867.9	4869.9	4870.4
	25	195,120	4846.5	4848.4	4849.0
	26	193,190	4835.6	4837.0	4837.6
	27	191,400	4822.4	4823.8	4824.4
	28	191,280	4822.3	4823.8	4824.4
Axtel Bridge	29	191,070	U/S 4822.2 D/S 4821.7	U/S 4823.7 D/S 4823.2	U/S 4824.3 D/S 4823.8
	30	190,940	4820.8	4822.1	4822.6
	31	188,070	4795.9	4797.4	4797.9
	32	184,510	4775.2	4776.5	4777.0
	33	182,740	4764.8	4766.4	4766.9
	34	179,370	4745.0	4746.4	4746.9
	35	177,520	4734.0	4735.4	4735.9
	36	176,100	4727.3	4728.8	4729.3
	37	171,180	4708.6	4700.0	4700.6
	38	169,870	4688.6	4689.9	4690.4
	39	169,720	4688.4	4689.9	4690.4

Table 5 (Continued)

FLOOD PLAIN REFERENCE DATA

GALLATIN RIVER

Identification	Reference Point Number	Distance From Mouth Feet	1972 Flood Elevation Ft. M.S.L.	50-Year Flood Elevation Ft. M.S.L.	Intermediate Regional Flood Elevation Ft. M.S.L.
Sheds Bridge	40	169,540	U/S 4688.4 D/S 4688.5	U/S 4689.9 D/S 4689.9	U/S 4690.4 D/S 4690.4
	41	169,280	4686.8	4688.3	4688.8
	42	169,000	4685.0	4686.5	4687.0
Railroad Bridge	43	168,720	U/S 4684.9 D/S 4683.1	U/S 4686.4 D/S 4684.5	U/S 4686.9 D/S 4685.0
	44	168,210	4680.1	4681.5	4682.0
	45	165,700	4663.2	4664.5	4665.0
	46	163,500	4650.9	4652.4	4652.8
	47	162,270	4641.5	4643.1	4643.5
	48	159,290	4616.8	4618.3	4618.8
	49	155,980	4602.8	4604.6	4605.0
	50	153,870	4592.2	4593.9	4594.4
	51	148,130	4558.1	4559.7	4560.2
	52	142,050	4528.7	4530.3	4530.7
	53	139,900	4516.8	4518.5	4518.9
	54	138,400	4506.2	4507.6	4508.1
	55	137,710	4506.2	4507.6	4508.1
Cameron Bridge	56	137,570	U/S 4506.1 D/S 4503.3	U/S 4507.5 D/S 4505.0	U/S 4508.0 D/S 4505.5
	57	137,330	4502.1	4503.5	5403.9
	58	136,250	4492.8	4494.5	4494.9
	59	134,020	4481.3	4483.0	4483.5
	60	132,320	4472.5	4474.1	4474.6
	61	131,110	4468.1	4469.8	4470.4

Table 5 (Continued)

FLOOD PLAIN REFERENCE DATA

GALLATIN RIVER

Identification	Reference Point Number	Distance From Mouth Feet	1972 Flood Elevation Ft. M.S.L.	50-Year Flood Elevation Ft. M.S.L.	Intermediate Regional Flood Elevation Ft. M.S.L.
	62	128,620	4455.2	4457.2	4457.7
	63	125,000	4430.4	4432.9	4433.3
	64	124,810	4430.1	4432.7	4433.1
	65	124,610	4429.9	4432.4	4432.9
Belgrade Bridge	66	124,400	U/S 4429.8 D/S 4428.8	U/S 4432.3 D/S 4431.3	U/S 4432.8 D/S 4431.7
	67	124,180	4428.6	4431.0	4431.5
	68	121,380	4410.4	4412.9	4413.5
	69	121,180	4409.7	4412.1	4412.7
	70	120,930	4408.9	4411.4	4411.9
	71	120,850	4408.5	4410.9	4411.5
	72	119,480	4400.0	4402.5	4403.0
	73	114,600	4369.1	4371.6	4372.0
	74	112,610	4357.2	4359.7	4360.2
	75	111,900	4354.6	4357.1	4357.7
	76	109,620	4339.4	4341.9	4342.5
	77	107,690	4333.6	4336.0	4336.5
	78	105,450	4320.5	4322.9	4323.5
	79	102,420	4300.9	4303.4	4304.0
	80	102,190	4300.5	4302.9	4303.5
	81	101,880	4297.8	4300.3	4300.9
Interstate 90 Bridge	82	101,700	U/S 4297.7	U/S 4300.2	U/S 4300.8

Table 5 (Continued)

FLOOD PLAIN REFERENCE DATA

GALLATIN RIVER

Identification	Reference Point Number	Distance From Mouth Feet	1972 Flood Elevation Ft. M.S.L.	50-Year Flood Elevation Ft. M.S.L.	Intermediate Regional Flood Elevation Ft. M.S.L.
Interstate 90 Bridge	83	101,620	U/S 4297.4 D/S 4297.3	U/S 4299.9 D/S 4299.8	U/S 4300.3 D/S 4300.3
	84	101,520	4296.8	4299.2	4299.8
Burlington Northern Railroad	85	101,400	U/S 4296.7 D/S 4296.1	U/S 4299.2 D/S 4299.0	U/S 4299.7 D/S 4299.5
	86	101,270	4296.0	4298.9	4299.4
Central Park Bridge	87	101,130	U/S 4295.9 D/S 4295.5	U/S 4298.8 D/S 4298.5	U/S 4299.3 D/S 4299.0
	88	100,940	4294.8	4297.8	4298.3
	89	98,930	4284.4	4287.3	4287.9
	90	97,920	4270.9	4273.4	4273.9
	91	95,300	4266.4	4269.0	4269.5
	92	90,760	4243.8	4246.3	4246.9
	93	88,700	4233.9	4236.4	4236.9
	94	86,580	4226.8	4228.8	4229.3
	95	86,480	4226.8	4228.8	4229.3
East of Manhattan Bridge	96	86,060	U/S 4226.7 D/S 4225.9	U/S 4228.7 D/S 4227.9	U/S 4229.2 D/S 4228.5
	97	85,160	4225.4	4227.2	4227.8
	98	84,480	4219.8	4221.8	4222.3
	99	82,800	4213.0	4214.9	4215.6
	100	80,500	4206.8	4208.8	4209.2
	101	80,480	4206.7	4208.5	4208.9
Abandoned Railroad Bridge	102	80,330	U/S 4206.6 D/S 4206.1	U/S 4208.4 D/S 4208.1	U/S 4208.8 D/S 4208.6
	103	80,200	4205.5	4207.5	4208.0

Table 5 (Continued)

FLOOD PLAIN REFERENCE DATA

GALLATIN RIVER

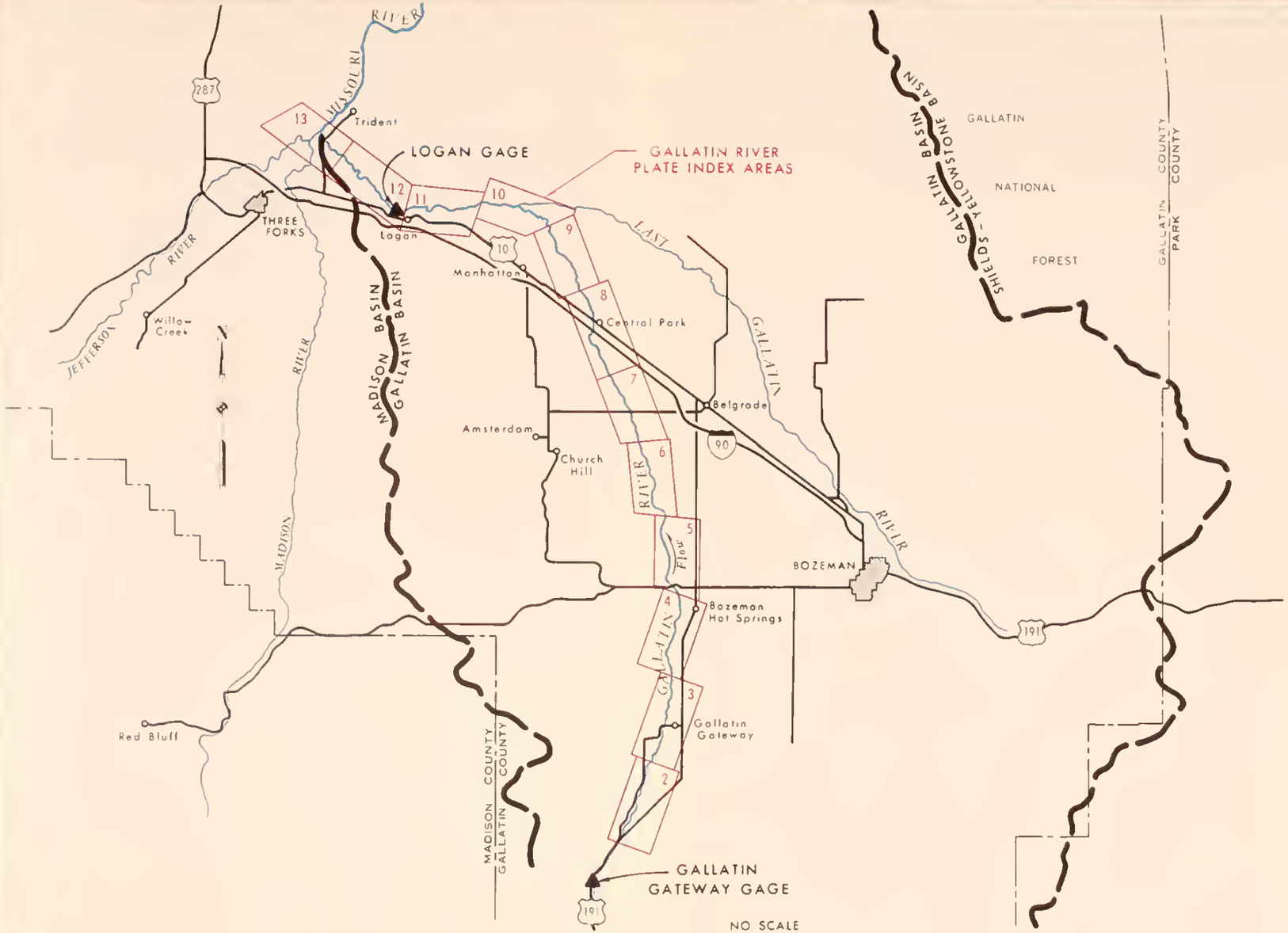
Identification	Reference Point Number	Distance From Mouth Feet	1972 Flood Elevation Ft. M.S.L.	50-Year Flood Elevation Ft. M.S.L.	Intermediate Regional Flood Elevation Ft. M.S.L.
	104	77,730	4197.3	4199.1	4199.8
	105	76,800	4190.4	4192.2	4192.8
	106	71,900	4180.4	4182.5	4183.0
	107	67,490	4165.3	4167.2	4167.8
	108	64,600	4155.2	4156.6	4156.9
	109	64,360	4154.5	4156.0	4156.5
Bridge North of Manhattan	110	64,280	U/S 4154.5 D/S 4154.4	U/S 4156.0 D/S 4156.0	U/S 4156.5 D/S 4156.5
	111	64,180	4154.5	4156.0	4156.5
	112	62,830	4151.9	4153.5	4153.9
	113	61,420	4147.6	4149.6	4150.1
	114	57,300	4139.6	4141.5	4142.0
	115	55,770	4135.9	4137.5	4138.0
	116	52,900	4132.3	4134.3	4134.8
	117	49,700	4124.2	4126.1	4126.5
	118	47,280	4120.7	4122.8	4123.3
	119	46,180	4115.6	4117.5	4118.1
	120	41,800	4109.6	4111.5	4112.0
	121	40,370	4106.2	4108.1	4108.7
	122	39,280	4101.4	4103.5	4103.9
	123	37,920	4098.6	4100.4	4101.6
	124	33,880	4093.4	4095.8	4096.3
	125	33,080	4092.4	4094.9	4095.4

Table 5 (Continued)

FLOOD PLAIN REFERENCE DATA

GALLATIN RIVER

Identification	Reference Point Number	Distance From Mouth Feet	1972 Flood Elevation Ft. M.S.L.	50-Year Flood Elevation Ft. M.S.L.	Intermediate Regional Flood Elevation Ft. M.S.L.
Logan Bridge	126	32,870	U/S 4092.4 D/S 4092.2	U/S 4094.8 D/S 4094.6	U/S 4095.3 D/S 4095.0
	127	32,620	4092.0	4094.4	4094.9
	128	29,290	4085.1	4087.6	4088.1
	129	26,660	4080.3	4082.7	4083.2
	130	24,970	4075.9	4078.5	4078.9
	131	22,090	4070.7	4072.8	4073.3
	132	18,540	4065.2	4067.0	4067.6
	133	16,430	4060.0	4062.5	4063.0
	134	14,420	4056.9	4059.5	4060.0
	135	11,100	4051.0	4053.6	4054.0
	136	8,080	4045.3	4047.7	4048.2
	137	4,680	4036.8	4039.3	4039.9
	138	1,930	4034.2	4036.8	4037.3
	139	820	4033.5	4036.1	4036.5
Trident Bridge Downstream Limit of Study	140	720	U/S 4033.5 D/S 4033.5	U/S 4036.1 D/S 4036.1	U/S 4036.5 D/S 4036.5



GALLATIN RIVER BASIN
GALLATIN COUNTY, MONTANA

GALLATIN RIVER

BASIN MAP
AND
PLATE INDEX MAP

U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
MAY 1973

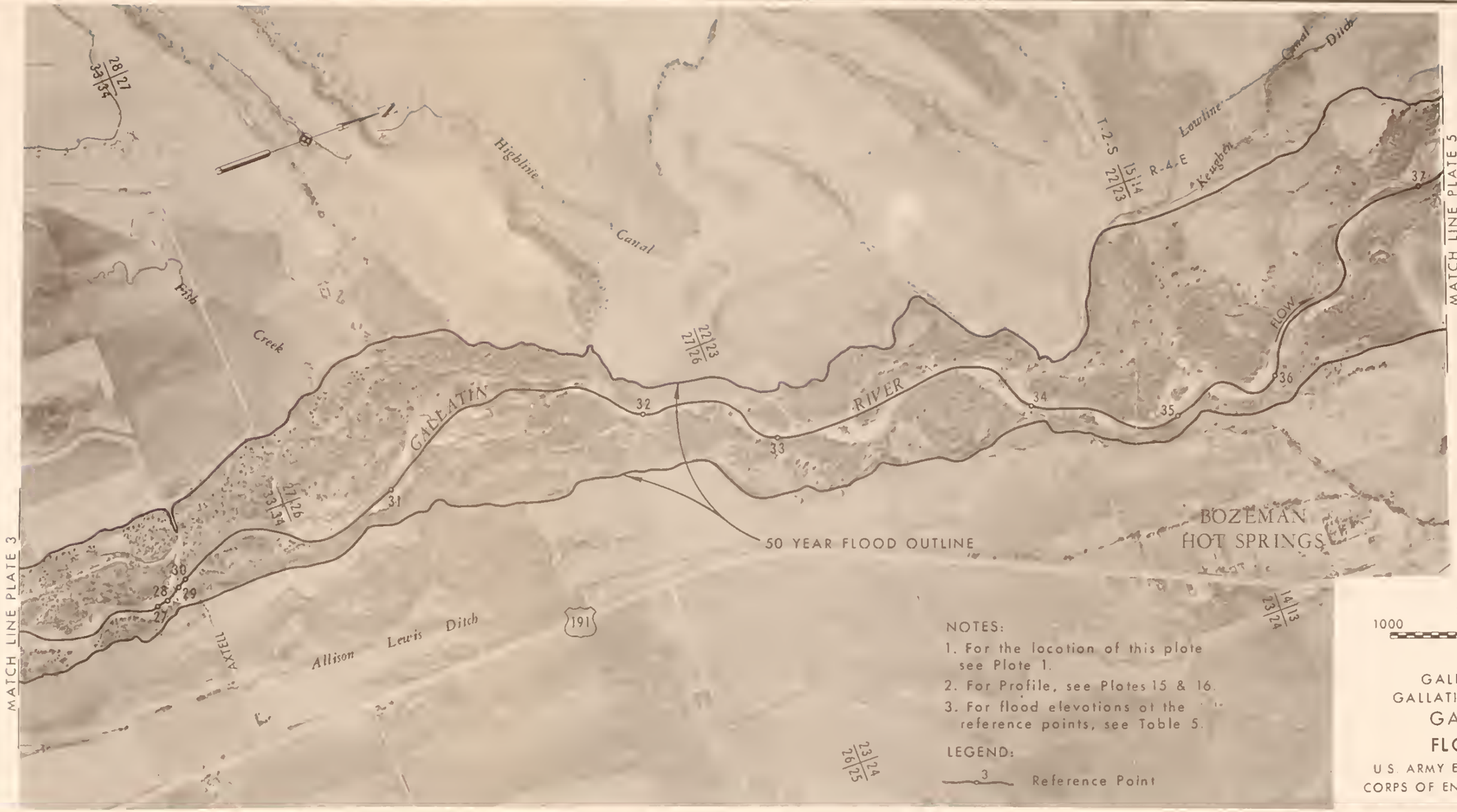
PLATE 1

Aerial Photos from A S. C S Flight July 1965

PLATE 2

Aerial Photos from A S C S Flight July 1965

PLATE 3



GALLATIN RIVER BASIN
GALLATIN COUNTY, MONTANA

GALLATIN RIVER
FLOODED AREAS

U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
MAY 1973

Aerial Photos from A S C S Flight July 1965

PLATE 4

Aerial Photos from A S C S Flight July 1965

PLATE 5

NOTES:

1. For the location of this plate see Plate 1.
2. For Profile, see Plate 17.
3. For flood elevations at the reference points, see Table 5.

LEGEND:

3 — Reference Point

SCALE IN FEET

1000 0 1000 2000

GALLATIN RIVER BASIN
GALLATIN COUNTY, MONTANA

GALLATIN RIVER
FLOODED AREAS

U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
MAY 1973

Aerial Photos from A S C S. Flight July 1965

PLATE 6

NOTES:

1. For the location of this plate see Plate 1.
2. For Profile, see Plates 17 & 18.
3. For flood elevations at the reference points, see Table 5.

LEGEND:

3 Reference Point

SCALE IN FEET

1000 0 1000 2000

GALLATIN RIVER BASIN
GALLATIN COUNTY, MONTANA

GALLATIN RIVER
FLOODED AREAS

U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
MAY 1973

Aerial Photos from A. S. C. S Flight July 1965

PLATE 7

NOTES:

1. For the location of this plate see Plate 1.
2. For Profile, see Plates 18 & 19.
3. For flood elevations at the reference points, see Table 5.

LEGEND:

3 Reference Point

SCALE IN FEET

1000 0 1000 2000

GALLATIN RIVER BASIN
GALLATIN COUNTY, MONTANA

GALLATIN RIVER
FLOODED AREAS

U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
MAY 1973

Aerial Photos from A S C S Flight July 1965

PLATE 8

NOTES:

1. For the locotion of this plate see Plote 1.
2. For Profile, see Plote 19.
3. For flood elevotions at the reference points, see Toble 5.

LEGEND:

3 Reference Point

SCALE IN FEET
1000 0 1000 2000

GALLATIN RIVER BASIN
GALLATIN COUNTY, MONTANA

GALLATIN RIVER
FLOODED AREAS

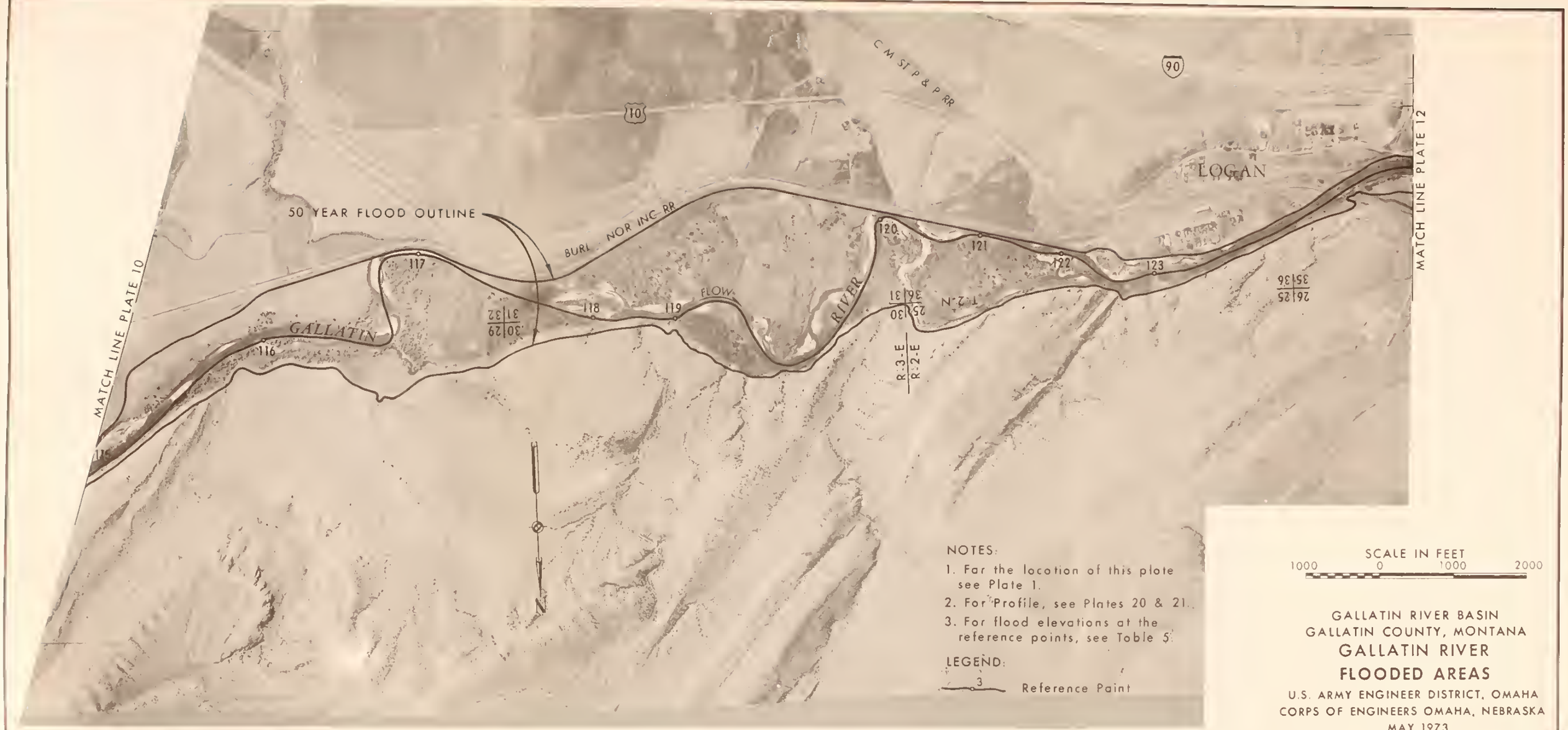
U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
MAY 1973

Aerial Photos from A S C S Flight July 1965

PLATE 9

Aerial Photos from A S C S Flight July 1965

PLATE 10



NOTES:

1. For the location of this plate see Plate 1.
2. For Profile, see Plates 20 & 21.
3. For flood elevations at the reference points, see Table 5.

LEGEND:

3 — Reference Point

SCALE IN FEET

1000 0 1000 2000

GALLATIN RIVER BASIN
GALLATIN COUNTY, MONTANA

GALLATIN RIVER
FLOODED AREAS

U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
MAY 1973

Aerial Photos from A. S. C. S. Flight July 1965

PLATE 11

NOTES:

1. For the location of this plate see Plate 1.
2. For Profile, see Plate 21.
3. For flood elevations at the reference points, see Table 5

LEGEND:

3 Reference Point

SCALE IN FEET

1000 0 1000 2000

GALLATIN RIVER BASIN
GALLATIN COUNTY, MONTANA

GALLATIN RIVER
FLOODED AREAS

U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
MAY 1973

Aerial Photos from A S C S Flight July 1965

PLATE 12

NOTES:

1. For the locotion of this plote see Plate 1.
2. For Profile, see Plate 21.
3. For flood elevations at the reference points, see Toble 5.

LEGEND:

3 Reference Point

SCALE IN FEET
1000 0 1000 2000

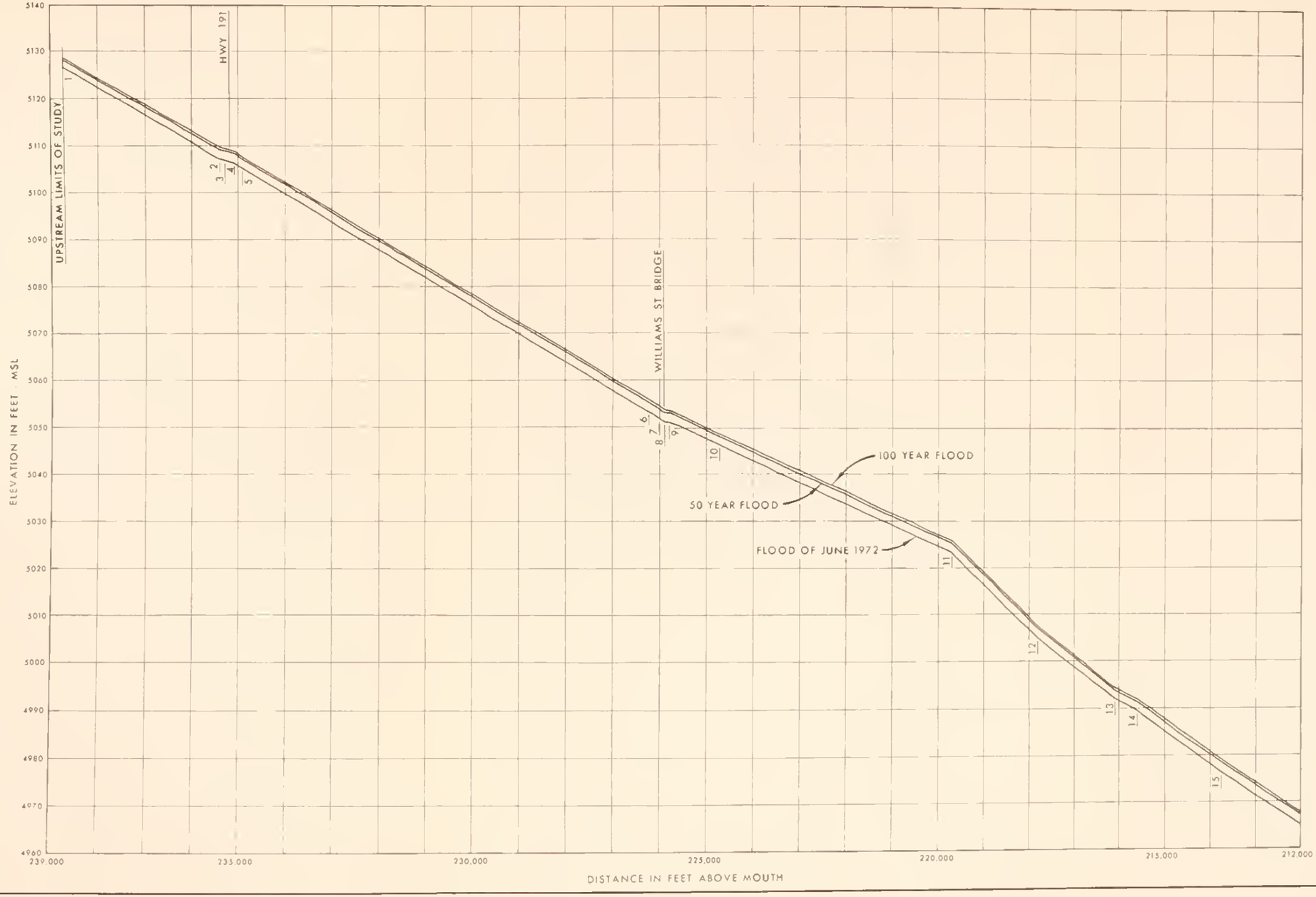
GALLATIN RIVER BASIN
GALLATIN COUNTY, MONTANA

GALLATIN RIVER
FLOODED AREAS

U.S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
MAY 1973

Aerial Photos from A S C S Flight July 1965

PLATE 13



NOTES

1 For location of reference points see Plates 2 & 3

2 For flood elevations at the reference points, see Table 5

LEGEND

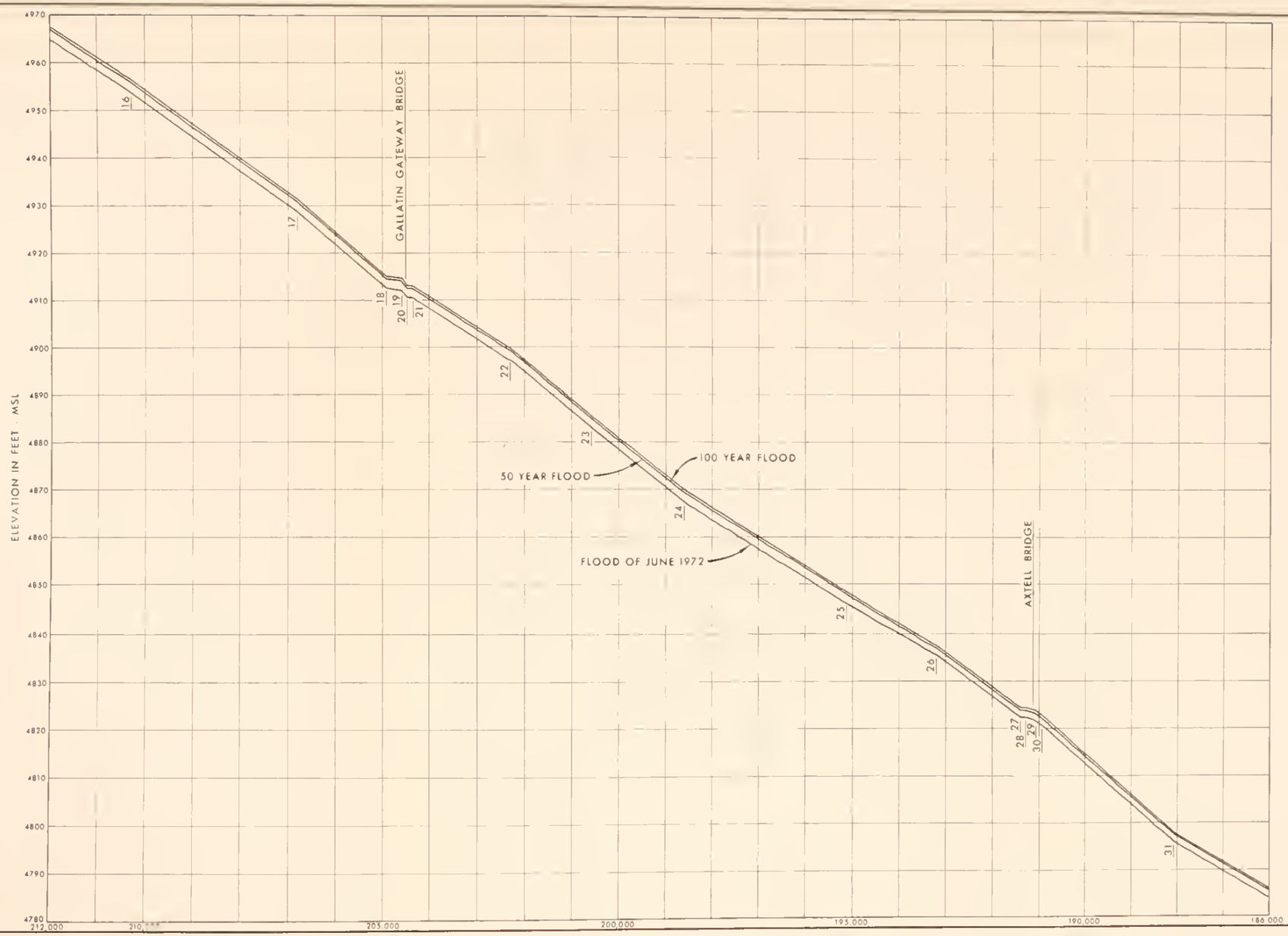
2 — Reference Point

GALLATIN RIVER BASIN
GALLATIN COUNTY, MONTANA

GALLATIN RIVER

PROFILE

U S ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
MAY 1973



NOTES

1 For location of reference points see Plates 3 & 4

2 For flood elevations at the reference points, see Table 5

LEGEND

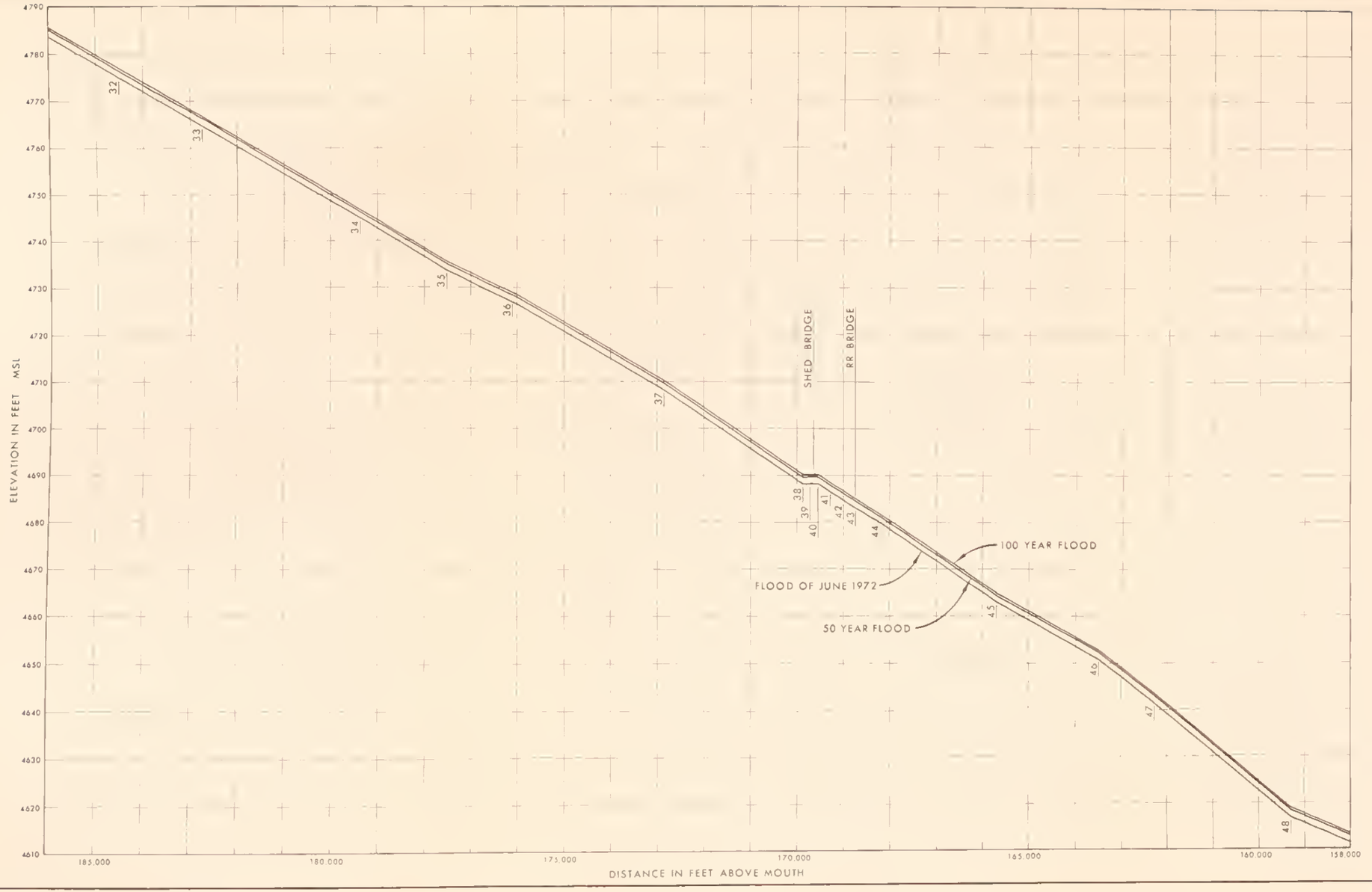
2 — Reference Point

GALLATIN RIVER BASIN
GALLATIN COUNTY, MONTANA

GALLATIN RIVER

PROFILE

U S ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
MAY 1973



NOTES

1 For location of reference points see Plates 4 & 5

2 For flood elevations at the reference points, see Table 5

LEGEND

2 — Reference Point

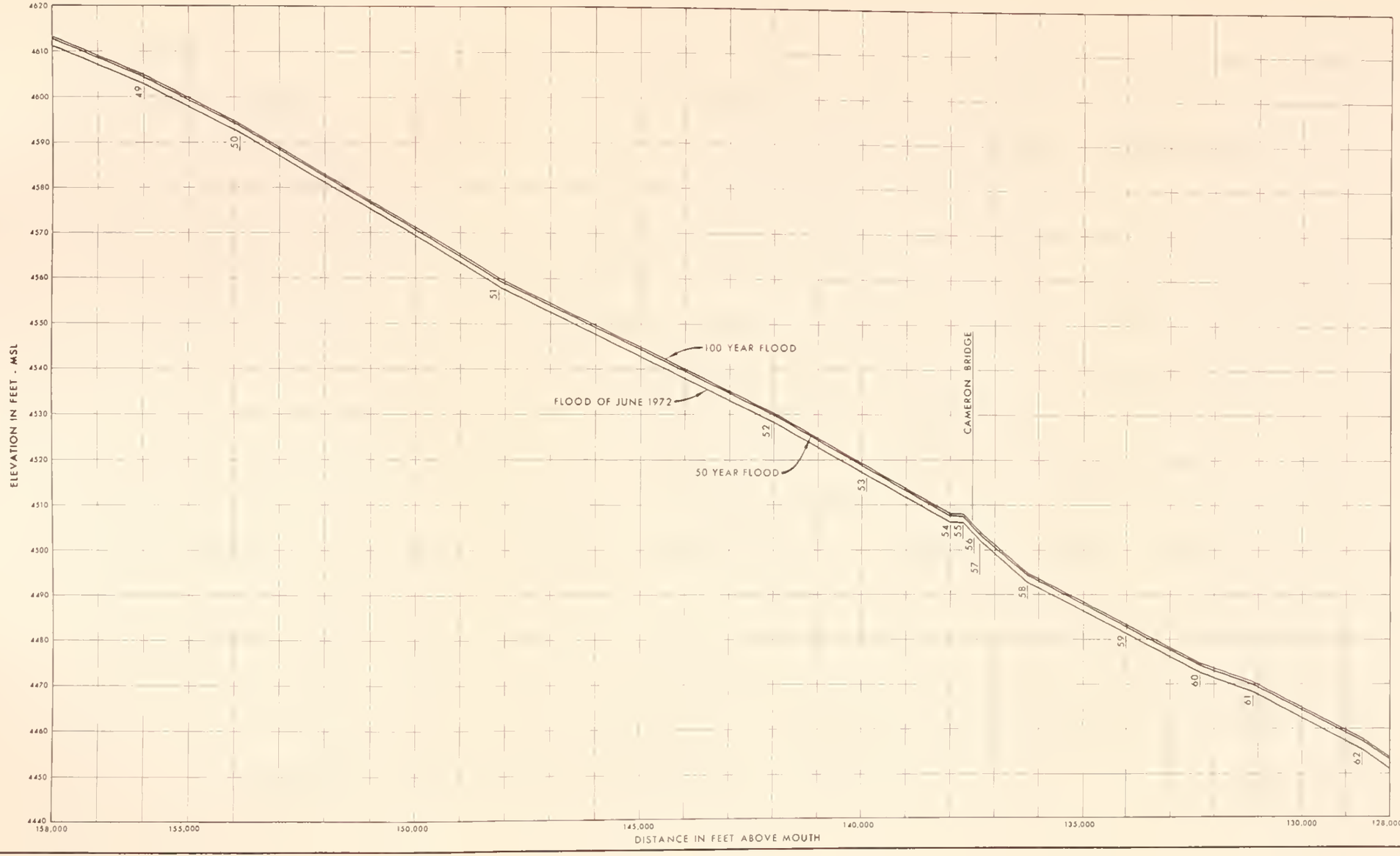
GALLATIN RIVER BASIN
GALLATIN COUNTY, MONTANA

GALLATIN RIVER

PROFILE

U S ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
MAY 1973

PLATE 16



NOTES

1 For location of reference points see Plates 5,6, & 7

2 For flood elevations at the reference points, see Table 5

LEGEND

2 — Reference Point

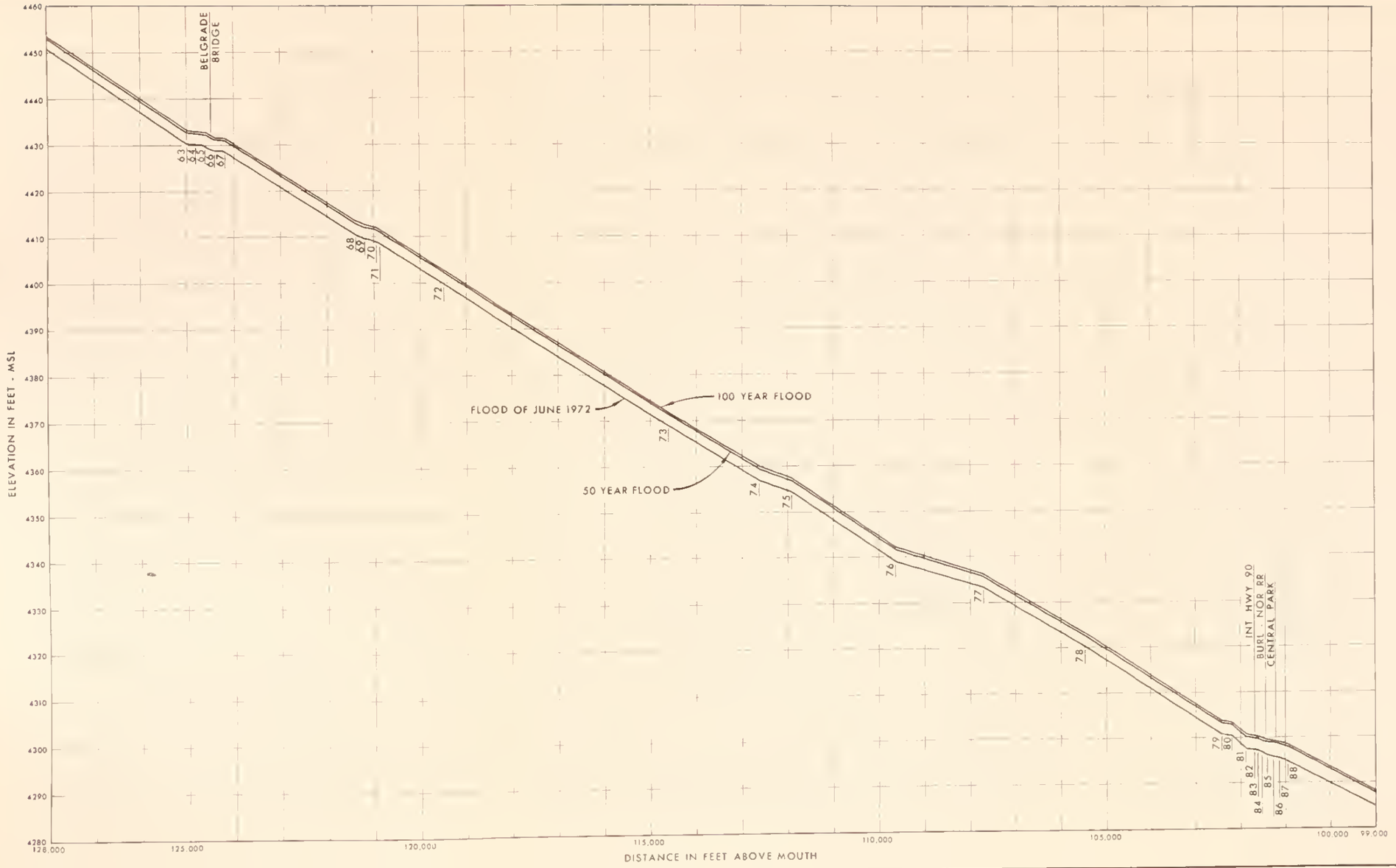
GALLATIN RIVER BASIN
GALLATIN COUNTY, MONTANA

GALLATIN RIVER

PROFILE

U. S. ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
MAY 1973

PLATE 17



NOTES

1 For location of reference points see Plates 7 & 8

2 For flood elevations at the reference points, see Table 5

LEGEND

2 — Reference Point

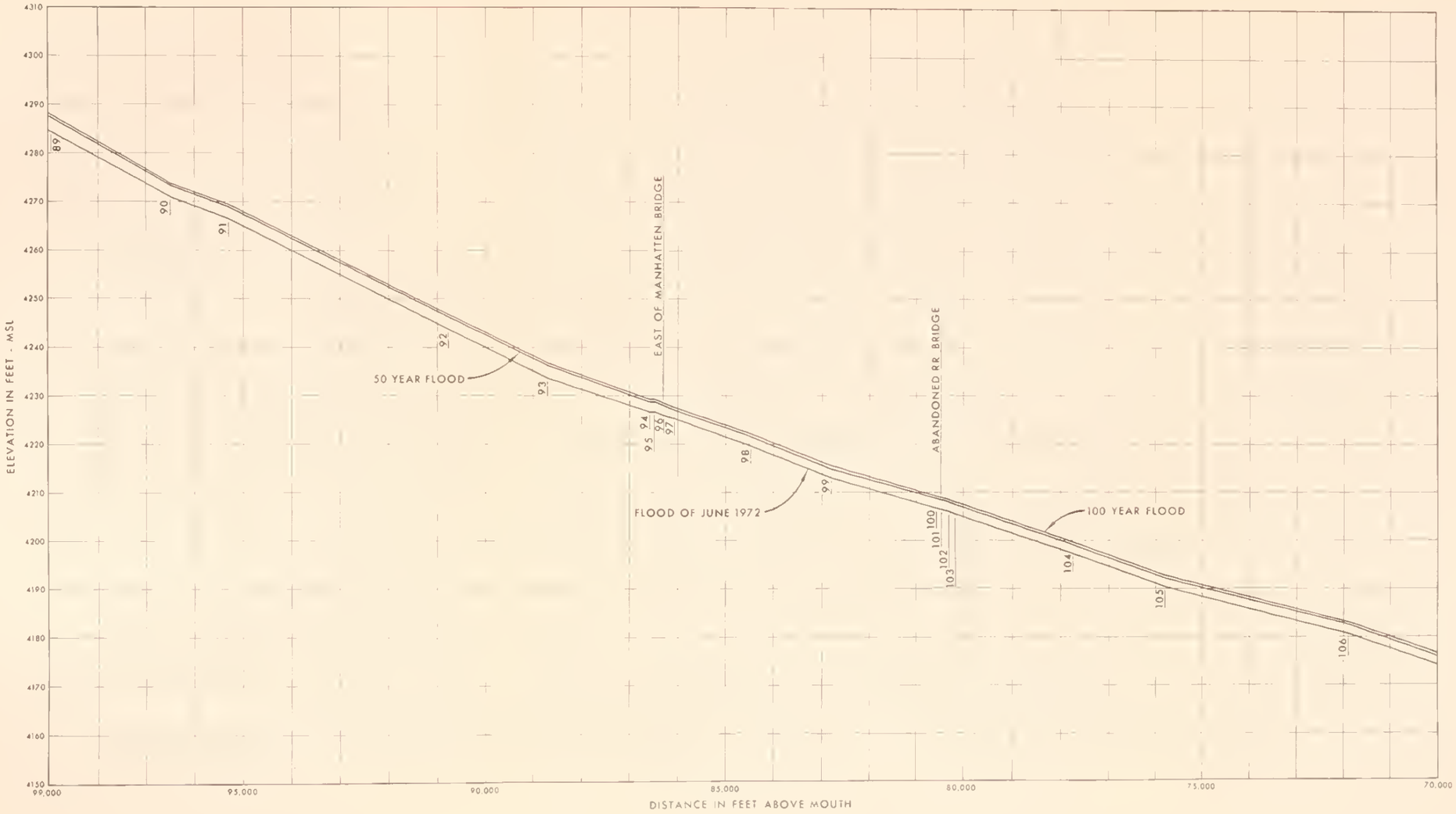
GALLATIN RIVER BASIN
GALLATIN COUNTY, MONTANA

GALLATIN RIVER

PROFILE

U S ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
MAY 1973

PLATE 18



NOTES

1 For location of reference points see Plates 8 & 9

2 For flood elevations at the reference points, see Table 5

LEGEND

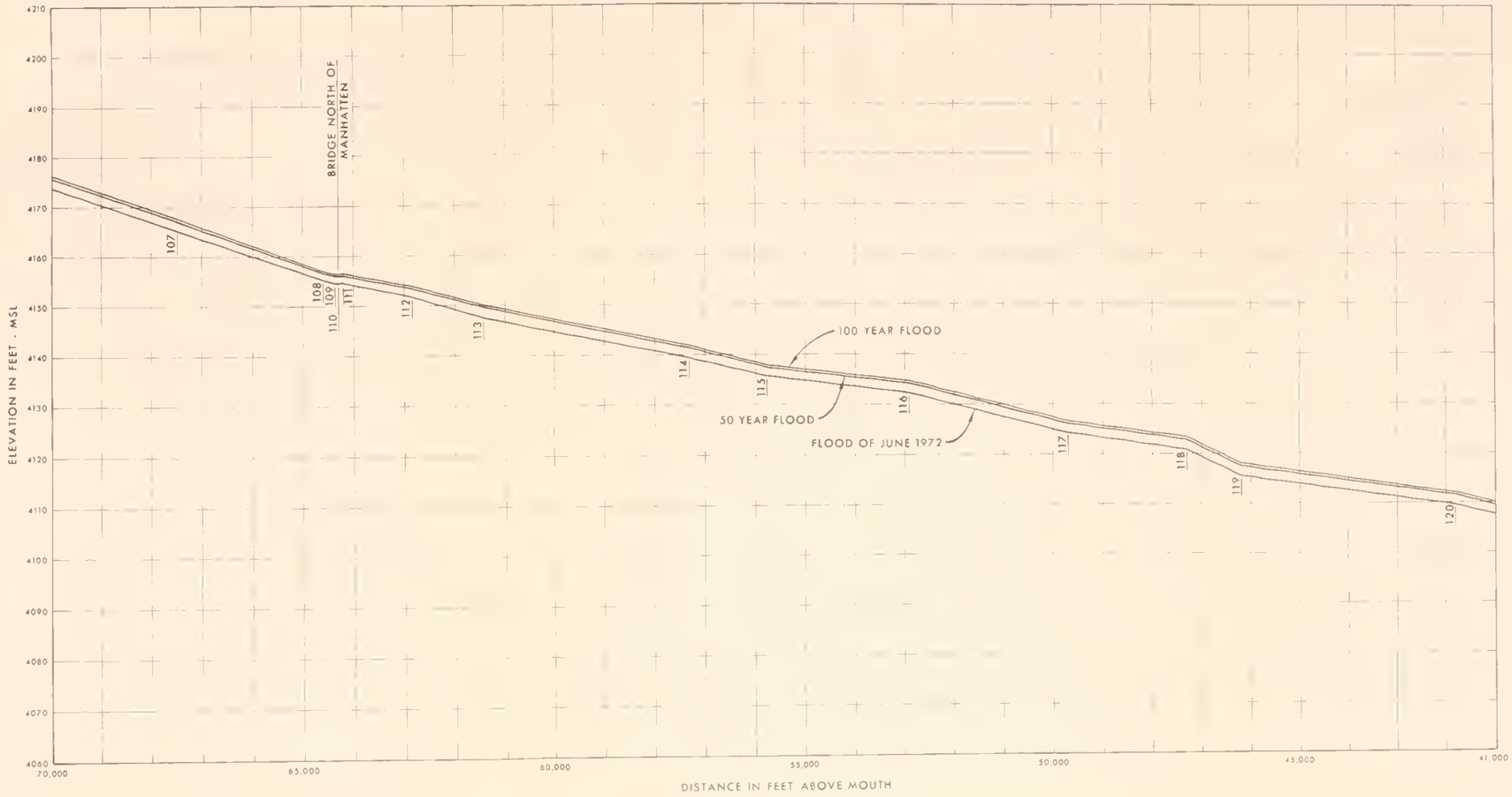
Reference Point

GALLATIN RIVER BASIN
GALLATIN COUNTY, MONTANA

GALLATIN RIVER

PROFILE

U S ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
MAY 1973



NOTES

1 For location of reference points see Plates 10 & 11

2 For flood elevations at the reference points, see Table 5

LEGEND

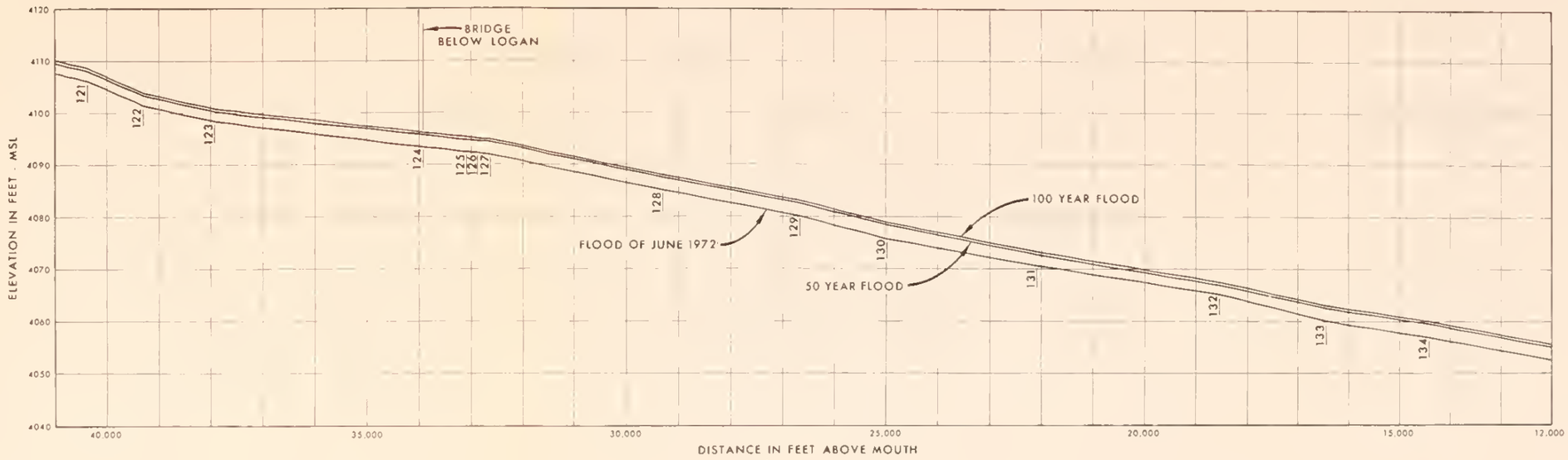
~ — Reference Point

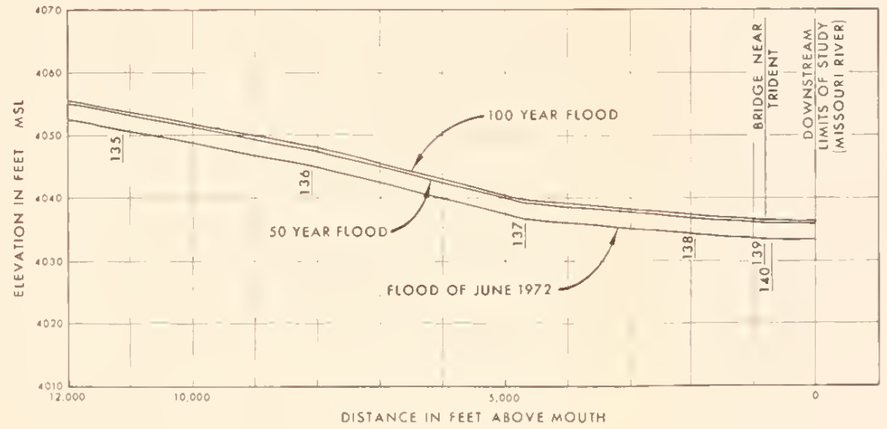
GALLATIN RIVER BASIN
GALLATIN COUNTY, MONTANA

GALLATIN RIVER

PROFILE

U S ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
MAY 1973





NOTES

1 For location of reference points see Plates 11,12, & 13

2 For flood elevations at the reference points, see Table 5

LEGEND

$\frac{n}{}$ — Reference Point

GALLATIN RIVER BASIN
GALLATIN COUNTY, MONTANA

GALLATIN RIVER

PROFILE

U S ARMY ENGINEER DISTRICT, OMAHA
CORPS OF ENGINEERS OMAHA, NEBRASKA
MAY 1973